HCI-SUMMARY

2. THE USER — basic human perception & cognition

comp = support tool (cognitive, comm, memory) | mediated by action

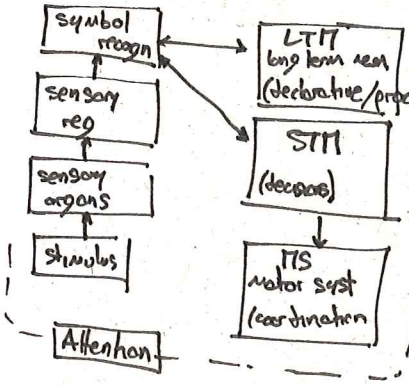
human as processors — Perceive → think → act

goal: easy-to-use systems

(H) ← cognition / action → (C)

(H): signal detection (noise) / recognition; scenes; focus; adaptation / learning / intuition; understanding info (coherent)

(C): algorithmic superior; detect/recognise known signals; fast reaction; measure/count/store incoherent data; syntactic manipulation of repetition



+ sensory mem (buffer)

Perception
- visual
- auditory
- haptic (touch)

Memory (LTS TM)

Action (MS)
- muscles
- voice

5 senses+
- vestibular (balance)
- body awareness (kinesthetic sense)
- temperature

Model Human Processor (MHP)

measure/predict
- exec time
- error rate
- training effect

α → symbol appears
β → see it
γ → cognitive process
δ → push button

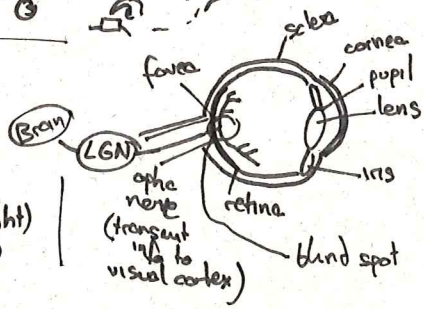
Processor	
perceptual	①
cognitive	②
motor	③

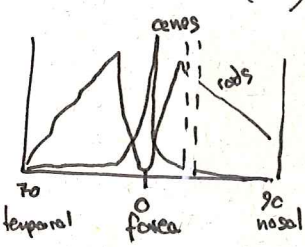
VISUAL SYST

light: cornea – lens – retina

iris → amount of light (open/close)

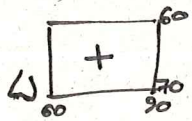
retina → decode info
- rods (low light)
- cones (color)





sharp vision = 2° fovea

visual field



rods
- light sensitive
- slow
- 120 M

cones
- less sensitive
- fast response
- 6 M, 3 types (S, M, L)

useful FOV: low char density 15°, high 1-4°

Cortex – functions

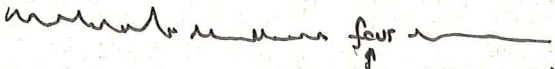
Obj/view based repr ①

- description as combination of structural parts (geons)
- view indep

- view dep 2D proj (neuron activ)
- recognition of features
- more accurate

Eye movement
- Saccade (fovea reposition) ~30 ms (10-100) ~≤ 600°/s amplitude
- Fixation 90% time (time between saccade) 150-600 ms

context dependant



4/5 letters in focus

230 ms ⇒ 13 char/sec ⇒ 780 char/min

- gaps in our perception (attention)

① Perceptual (receive signal & store in buffer)

Tp ≈ 100 ms (50-200)

Bloch's law: R = I·t (exposure time) — response intensity

⇒ min 10 Hz fps

② Cognitive (operates on chunk of info, unit)

Tc ≈ 70 ms (25-170)

Chunking (category) makes it easier

... oo ...

STM + LTM: working mem (cognitive process control)

repetition = form connections

STM: 7±2 units (2 s) max; 3±1 (7 s) avg (1/2)

LTM: declarative (facts); procedural (how-to do)

unlimited capacity ④; organization ⑤

③ Motor

TM ≈ 70 ms (w/out perceptual control) (30-100)

(70/5 = 70 ms)

closed loop (70 corr)

processing time = Tp + Tc + TM ≈ 240 ms

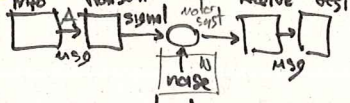
3. USER MODELING

- evaluate input devices
- optimize UI

models:
- throughput in aimed movements (click icons, pick items)
- time to hit target

Fitt's law

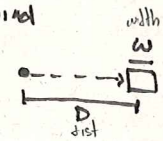
Shannon



C = H(sig) − H(noise) = B log₂((S−N)/N)

movement = info processing task

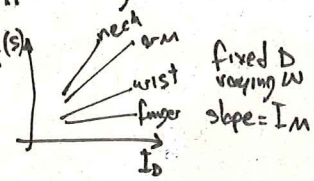
MT = Tpos = In · ID — index of difficulty = log₂(2D/W); index of movement = 100 ms/bit (const)



speed ↔ accuracy (amplitude/speed/variability)

ID = # bits (info to specify movement)

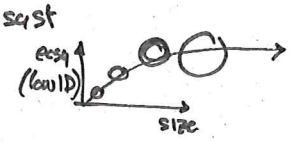
IP = ID/MT (bits/s) index of performance (device/limb dep)



double dist → extra const time (log)

Thesis: fixed info capacity of motor syst

benefit: increase size of small targets



Bandwidth: of muscle group & input device

target acquisition: ballistic + corrective | more than zooms means visual feedback control

Feedback loop: movement = multiple ballistic sub-mov + error ε

each 240 ms

$n \cdot (T_p + T_c + T_m) = T_{pos} = I_m I_D$

$X_1 = \varepsilon D_0 = \varepsilon D$, $X_2 = \varepsilon^2 D$] stop when $\varepsilon^n D \leq \frac{1}{2} W \Rightarrow n = -\log_2\left(\frac{2D}{W}\right)/\log_2 \varepsilon$

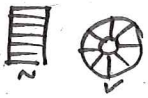
$\Rightarrow I_m = \frac{-(T_p + T_c + T_m)}{\log_2 \varepsilon}$

more efficient icons → use edge

∞ area (width)

- windows/MAC
- office

mini-toolbar: close to mouse (D)
far-away icons: larger (W)
grouped by functionality



pie menu
- bigger
- closer

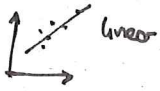
(H)as comm channel

$MT = a + b \log_2\left(\frac{A}{W} + 1\right)$ — amplitude (distance), target width

consts: a = reaction time, b = device/user dep

I_D [bits]

(see shannon pencil) → SHANNON'S FORMULATION

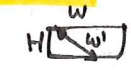


effective target width

(shannon analogy – white kernel noise)

$\frac{A}{W_e}$

2D motion (UI)



$I_D = \log_2\left(\frac{A}{x} + 1\right)$ possible: $\min(W, H)$ / W'

$I_D = \log_2\left(\sqrt{\left(\frac{A}{W}\right)^2 + \alpha\left(\frac{A}{H}\right)^2} + 1\right)$ — Welford / Buxton

3D: $I_D = \log_2 \left/ \alpha \text{ or } W \right. + \beta\left(\frac{A}{D}\right)^2$ — Zhai pick (book, phone ...)

Angular motion

consider rot, not ballistic motion

$I_D = \log_2\left(\frac{\theta A}{\theta W} + 1\right)$

Steering

trajectory based (nested menus) → sequence of targets (list / pie)

N steps: $I_{DN} = N \log_2\left(\frac{A}{NW} + 1\right)$

$I_{D\infty} = \frac{A}{W \ln 2}$

along curve: $I_{D_C} = \int_C \frac{ds}{W(s)}$, $T_C = a + b I_{D_C}$

compare devices: data → fit line → a,b params

(mouse/stylus/trackball, point/drag)

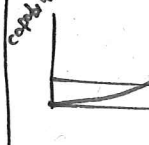
es:
design optimal keyboard (qwerty designed to put frequently used keys far away → remove jams)

Fitt's law — rapid aimed movt

- ⊖ body asymmetry
- ⊖ no cognitive factor
- ⊖ no parallelization (multiple hands/fingers)

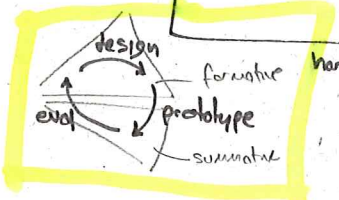
4. ANALYZING USER EXP

experimental design



true to back flight / videogame feel / ballot] user evaluation

HCI process



hard to get it right @ 1st

Eval type

- Formative – early – building the right thing? | plot prog/new progress to improve

understand user → observe/model, create scenario (existing behaviour)

Prototype
- low fidelity (paper
- interactive (not clean, part of function) es. Siri (see end result)

- Summative – sol working? improved? | at the end of cycle to assess

Tool/UI quality
- analytical (properties) — es axe wizards/shop
- empirical (how used) — give to non

QEM (quantitative eval method) → obtain scientific statement – opinion

es: users 10% less errors interface A over B

Metrics
- effectiveness (complete task)
- efficiency (amount effort)
- satisf (happy exp)
- → custom-defined (#clicks, ...)

] solve questions

Cause ≠ Correlation

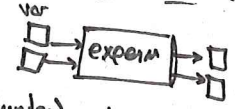
- precede effect
- no other explanation
- top: controlled experiment (suspect cause present/absent, all rest =)

⚠ baby-eyeogne (area/country)

Design empirical study

3 key questions

1. what is being compared? indep. variables
2. what are they being compared in? dep. " (metrics)
3. what else varies? (external var)



var: categorical (country) / ordinal / cardinal (#) (interval) int float | see examples

variable control & changed to see effect

var measured and compared (metric) that depends on indep

Quasi Experimental: correlation exercises → grade | better ones perceived, no causality

sol: randomly pick

⚠ reproducibility
don't rely on participation group (students), sample size

validity: internal + external

Experimental design

within-subj: everyone does everything

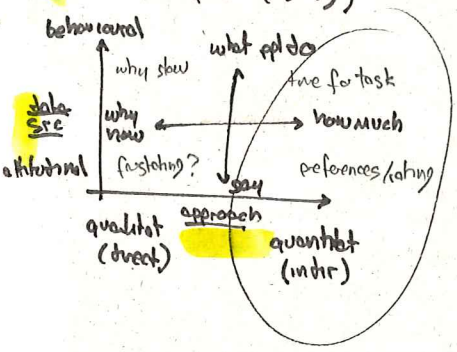
between-subj: only 1 condition per group (reduce # exp. orderings) 2

Latin Square counterbalancing

permutation → huge (6! = 720)

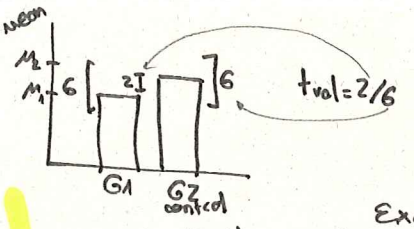
ABCD	→ 1 per row/col (shift) then rand rows, cols
BCDA	
CDAB	
DABC	

② relevant quantities (measure right stuff)
② use template (es kg)

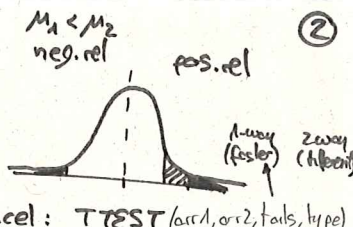


memory ≠ #items recalled

find things to measure!
- ratio of true talking
- feeling



$p < 0.05$ (5%) arbitrary cutoff → statistically significant difference = interesting (incompatible with H_0)
⊖ arbitrary



Excel: TTEST(arr1, arr2, tails, type)
paired: 2-sample
within/between (equal/≠ var)

(★★★ → ask for text after initial commitment → higher participation)

t-test
⊖ assume gauss
⊖ need same sample size
⊖ data must be indep

5. ANALYZING EXPERIM. DATA (Statistics)

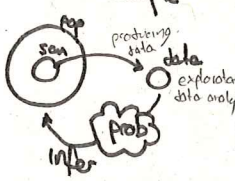
↳ supplente

③ eliminate/control external var (has effect on exp)
- natural variance (age, sex)
- explicit (cultural bg) ← show lack of effect

"what is the effect of ___ on ___? it causes difference?"

INTERPRET RESULTS:

Pop vs Sample



draw conclusion (data analysis)
sample must be representative
model: tables / diagrams ... mean, variance
infer: estimate validity of model

Descriptive statistics
Inferential stat.

Model fitting

$$\text{outcome}_i = \underbrace{\text{model}_i}_{b_0 + b_1 X_{4i}} + \text{error}_i$$

// linear model

models

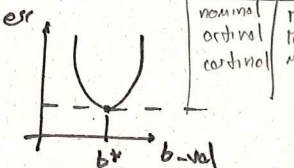
mean $O_i = (\bar{b}) + \varepsilon_i$
corr $O_i = (b \cdot \text{Predictor}_i) + \varepsilon_i$
regression / T-test $O_i = (b_0 + b_1 \cdot \text{Predictor}_i) + \varepsilon_i$

es. friends #

Descriptive statistics: describe data pop

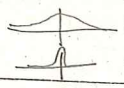
(ratio lvl)

tot err $= \Sigma (x_i - \bar{x})$
sum of squared err (SS) $= \Sigma (x_i - \bar{x})^2$
variance $(\sigma^2) = \frac{SS}{N-1}$
standard dev (SD) $= \sigma$
mode (greatest freq)



data		
nominal	ordinal	cardinal
mode	median	mean

→ best possibility



parameter fitting: (estimation) least squares fitting

vertical offset
perpendicular

problem: unknown error

Inferential statistics: give estimate of validity of findings for pop

Hypothesis testing

H: change in X (explains) influence change Y
H_0: no inf! (no diff)

goal: show H_0 incompatible with data
we are left with H to believe in

m: believe H_0
out: p-value → - high ⇒ believe H_0
- low ⇒ don't believe H (for now)

main q: < does ind V cause diff on dep V ? >

effect size: means difference (unknown → threshold ?)

A/B testing (A control, B treatment)

1 cat	1 interval	indep	dep

Student's T-test: check if 2 means reliably different

$t = \frac{\text{variance between groups}}{\text{variance within}}$

large t ↑ ≠ group
small ↓ SIMILAR

$t = \frac{\bar{B} - \bar{A}}{\text{var } B}$

Analyzing data.

experiment design	param. test / metric	non-parametric test
2 gr, ≠ partic (1 indep. var)	indep T-test	Mann-Whitney
= partic	Dep. T-test	-
≥3, ≠ ( )	1-way indep. ANOVA	Kruskal-Wallis T
= partic	1-way repeated ANOVA	Friedman's
...		

Which statistical test to use?

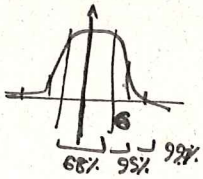
ANOVA (analysis of variance) - single factor (comparing more than 2 samples) F-value

Non-parametric test
Chi-square test

Standard error: measure how good a representation of the true population a sample is

central limit thm

$\sigma_{\bar{x}} = \frac{SD}{\sqrt{N}}$ std. err approx



compute confidence interval: $\sim N(0,1)$

lower = $\bar{X} - \left(\frac{z \cdot p}{2} * SE\right)$
upper = $+$

⇒ exam relevant example (p38) Qwerty / swipe
- indep var
- dep
- experiment design

6. EXPERIMENTS DISCUSSION

Holodesk: H_1 ← supported by test
H_2

stereo**scopic** **mono** vs **stereo** depth cues
- persp. foreshortening
- occlusion
- shadows

→ use ANOVA → stereopsis

measured variables
indep:
indirect — IHD
direct — DHD
stereo direct — SDHD
dep:
tct (task compl time)

Z-adjustement
Influence of spatial location — stereo ⊕ 3D illusion

Study of haptic feedback on touch sliders
↳ good for difficult tasks → touch feedback facilitates
2 techniques (feedback/not)
2 difficulties
6% tech
20% diff improvement
+ qualitative feedback (comment) es "helpful"

Running HCI experiment multiple universes (parallel)
p-value varies a lot between replications
☹ scientists rely too much
P-value dance

NHST (null hypothesis significance testing) • must eliminate method
use **BASP** ↳ p-val, t-val significance **MISUSE** ⇒ false solutions
, parameter estimation

power = P(reject H_0 | H_1 is true)

Type I errors 5% // reject true
Type II 30% (power 0.7)
1 − %

better sol → use larger samples
↘ Bayesian estimation → ☹ costly
☹ increase power with better measurem
☹ Dance of samples slow convergence

⚠ wrong intuition: statistics stabilize noisy data (don't)

robust sampling if simil datasets yield similar interpretations/plots
⇒ don't draw conclusion, present facts (let readers do it)

- embrace uncertainty / don't trust press
- discard unfavorable data bad / biased / overgeneralization

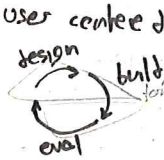
keep dances in mind, seek robustness

wiki "misuse of statistics"

*see MIUS

7. UCD & INTERACTION STYLES

user centered design process

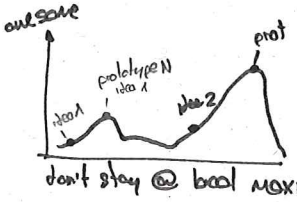


optimize product around how user can/want/need to use it, instead of forcing user change to accomodate it

(2007) iPhone vs IBM Simon → marketing, same features

multiple iterations beat single-minded commitment of 1st idea

Design process: get it right!
design right / right design



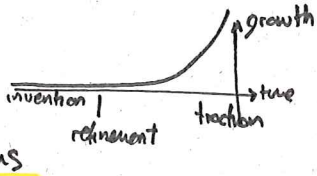
don't stay @ local maxima!

test many to have good idea
→ have lots of ideas

Mouse (1963) – birth of UI → 30 years to become popular

Xerox windows UI

Multi-touch tablet ('85) • pressure sensing + capacitive
Smartskin ('02) • hand pos, precise + hover
fingerworks (apple acquired)

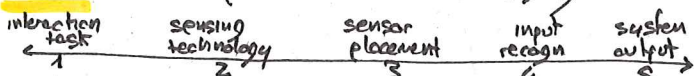


Established
Interaction styles & paradigms
- commands → comm. line
- dialogue system → (speech based)/windows, popups
- search/browse → itunes/web
- direct manipulation → interfaces (DM)

3 golden rules of manipulation
- visibility (objs & actions)
- rapid, reversible, incremental actions (undo)
- replace complex syntax with direct, visual manipulation of obj (memorability)

Emerging Interaction Paradigms p42
- Context sensitive UI (google Now)
- Natural language interfaces (AI + alg) SIRI
  – UI problem aswell (usage, .../novelty?/...
- AR/VR
  – ultimate goal: room where computer has control of matter
  – Holodesk
  – Kinect fusion → minecraft AR

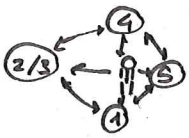
AIT research (advanced interactive technologies)



Sensing: noisy/sparse data
human behaviour
- sensor characterization
- network architecture

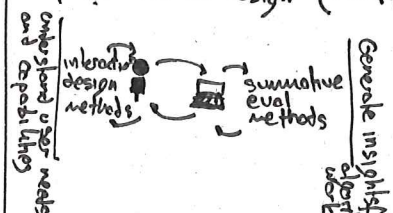
HW ↔ UI

Computational interactivity: nowadays able to use complex



- sense (H) activity
- computational ui design

Computational UI design (UC(T)D)

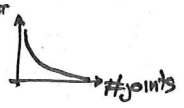

understand user needs and capabilities
interaction design methods
summative eval methods
generate insights for alternative designs

es: rig anim with a tangible input device
1:1 mapping
assign joint → bones
splitters → branch. nodes

Pose error: $\underset{D,P^D}{\operatorname{argmin}} \sum_i \| w\,(F(c, M(p_i^D)) - F(c, p_i^C)) \|_2^2$

identify important dof

quadricopter example



Next: Nina Noone
- interaction design
- pen-based UI
- qualitative method

PART II

8 INTERACTION DESIGN

design process & principles

- all applications/devices

understand user ⇒ innovation

⊕ support users/enrich exp
⊕ goal: unaware of technology (natural)

study individuals, settings

Design Process

requirement analysis (user study (field)) → prototype (design/develop) → eval (user-study (usability))

adapt/refine

agile methods
add functions

Requirements

- what should syst do?
- model: users & syst
- prototypes

scenarios (narrative descr)
user perspective
actual (usual) & potential (unusual)
→ use cases

storyboarding (sketch idea) → comm

sketching ≡ design ideas (generation/elaboration/choices/engineering)
PROCESS
TOOL (express/develop/communicate)

- clear vocabulary
- defined res
- consistent style

Prototype (interact & get feedback)
STEPS: define tasks → create prototype → perform walkthrough

- paper
- select flows/cheap
- creativity

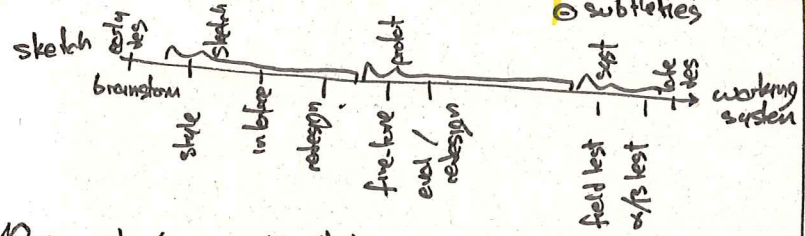
create user profile → screens → elements

useful to user
elicit action
helps success of product

plan & do study
- facilitator guides
- computer simulates
- observers take note
- helpers provide info
- user

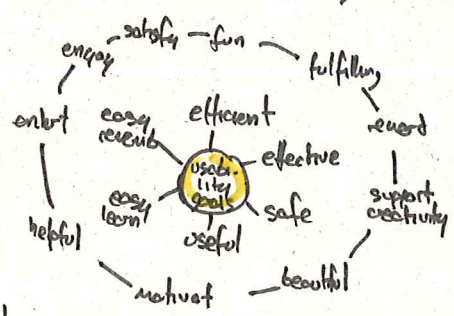
⊕ raise issues (requirements/funct)
⊕ detect problems (navigation/task-workflow)
⊕ screen layout issues
⊕ detect unclear concepts/documentation/terms

⊖ interaction/input
⊖ times (response)
⊖ scrolling/animation
⊖ subtleties



10 min rule (name → be able)

- ⚠ complex syst
- existing knowledge



Design principles

- visibility → guide user. function must be visible (or category)
- feedback → let know what's going on (visu/audio/haptic) - immediate
- constraints → restrict interaction/reduce error/focus on task
- mapping → input control & effect, natural
- consistency → same look, ways of achieve task (menu category) app intern
- affordances → phys. properties give clue (push, rotate, ...

Website → minimalistic, no affordances (link, button ...) ③

trade offs between principles → which ones? examples!!

goal: ⊕ easy to learn: use prior knowledge (automatic stuff) instead of cognitive load

good ~ bad — obj-action matrix (task-focused)

MAKE IT SIMPLE (find a better ex)

reading is unnatural (must be learned)
speaking is (innate)

nature vs advanced reader (assemble words, Wernicke/Broca's areas)
no analysis, recognize word as whole

many non-skilled readers
→ avoid too much text-repetition
→ limit centered text (eyes go back to begin of line) (⚠ lists/... structure lost)
→ select font/colors/style appropriately
⇒ we perceive what we expect

Natural vs Artificial colors

Leaf Lawn ⇒ poor @ distinguishing shades of blue (links)
relative absorbance of λ

often colour blindness (5% pop) • saturation • brightness — distinguish by

fovea: 1% area, 50% visual cortex — connect to ganglial neuron cells 1:1 → higher resolution in centre

peripheral vision: good for motion/low res cues
↳ error msg missed if not where fovea is
↳ put on LOGIN — place appropriately

Structure: vision optimized for it

::: :: : ← bad ex: organizes vertically

$ - $ bad → $ $ $ ✓

078123 ✗ 078 123 ✓ (numbers & dates) (spaces, (), -)

similar things must go together

⇒ structure input forms

calendar

visual hierarchy

1. 2. 3. ✗ 1. 2. ✓

bold, size, spacing (paragraph), align, prominence (contrast), relationship (group similar content)

we look for continuity

figure/ground

Gestalt Laws

- emergence – complex pattern formation from simple elem (schmata)
- multistability – ambiguous, pop forth-back, 2 interpret
- reification – perceived obj contain more explicit spatial info than represented (illusion contours)
- invariance – geometrical obj recognized indep of rot/transl/scale
- closure – shapes/letters perceived as whole when not in reality
- similarity – form group if similar in shape/col/..
- proximity – — — close together
- continuity – integrated into perceptual wholes if aligned

↝ not ↝

use spacing + similarity = structure

STM volatility (distracted/focus shift)
↳ break text into units ~10s
→ google: remind ppl of search (unbroken concentration short)

moded interfaces: effect of action depend from mode
→ more functions than controls
⊕ provide cues of mode

no popup with info. users won't remember → give step by step

progression bar (keep track of what's up)
show progress, color code. remember users

forget cleanup (ATM, copier, logout). remember user before completion

recognition (see-choose) easier than recall (remember-type) | type: fast if you know what or doing

visual cues: icons/thumbnails/visited links/...

9. VIDEO ANALYSIS

observe users more revealing than asking
⊕ introduce new techn / understand changes | es ambulances (fail)
⊕ understand why problem occurs → no study of settings

can be applied to everything

es london underground → video studies provided understanding

digital museum guides
⊖ less interaction/focus

VIDEO ⊕ replay/details ⊕ analysis
↳ capture - actions - verbal com
mundane reveals complex action/behav
- expressions/gaze - body mov/gestures

STUDY • practical/ethical issues
- data collection
  - many settings → get access: get management onboard (trust) their interest
  - formal consent (public space/external ppl) → get participants
  - not reluctant!!
- data analysis
  - ⚠ not optimizing work force
- result presentation

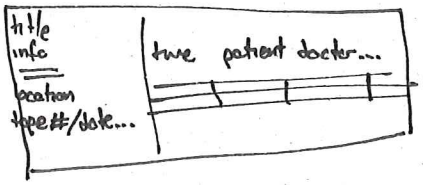
CCTV culture (used to it)
- may need to blur/privacy (individuals/organizations)

storage/access
- who owns it/access
- where/how long stored

planning
- preliminary field work
- record (sample)
- review
- record (further data)
- analize

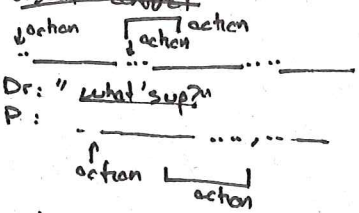
Recording • issues
- camera pos/audio/participants
  - (fixed/move) (1/multiple) ...
  - wide-angle ⊕ overview
  - close-up ⊕ details
  - quality & placement
  - ↳ get them to speak
    - (think aloud)
    - work in pairs

analyze data
- cataloguing + review (substantial/analytical)



transcribe events/segments/dialogue

transcribe
visual ~~conduct~~



— emphasis
: extension of sound
? tone up
(.) gap < 2/10s
° quieter
= no interval
. tone down
(#) gap in 10s
(( )) hard to describe

• glance = readiness to listen
new technology influences relationships
→ detect all interactions

VBZ tickets

10. BEYOND MOUSE & KEYB.

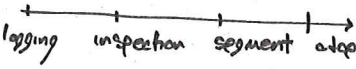
- cross-dev applications
- touch interaction
  - multitouch / supported gestures
  - recognize users / issues

FBTouch
- basic touch optimization (more space)
- multi-touch (drag-n-drop)
- device-specific adaptations

measure time for different tasks

- touch event handling
- tracking/coord capture, delegation
- touch device detection

W3Touch



compare versions (Desktop, W3T, App)
keep log of interaction → detect issues
Wide range of personal devices → need cross device apps

Mobile spread mobile (app/web) desktop

Browser
App] better user experience finger friendly

adapting content (browser) < develop modes of interaction (app) | responsive design

design notifications for touch
→ impact on task performance & U experience?
→ adaptation techniques?
- adjust areas (touch)
  - font size
  - paragraph
  - drag/zoom/...
  - orientation
  - user pref

Tilt & tap (Jquery plugin)
- jerk tilting
- continuous tilting

feedback: - audio
- vibration
- visual

can be cross devices

Motion sensors
- accelerometer
- gyroscope

→ speed, motion (tilt), orientation

Developer study / User study

Design (type/goals/tasks) → Recruitment → Carry out → analyze data (eval)

questionnaires ⊕/⊖

teens
no lab environment
skills / forced to use plugin
eval / feedback

Dev competition study

creativity? 3 participants ⊕/⊖ capabilities / design process

✗ perfect ∪ study → but revealing some problems is good (like testing)
↳ successful if you find ones

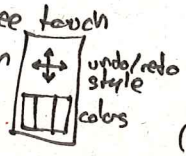
Participants: representative? reported data ≠ observed data ④
Tasks: right difficulty? true limit?
Recording: does it affect participants?
Eval: see useful features (to improve) preferences. Threshold for differences?
↳ design right ones

observation influences performance?

M. CROSS DEV CASE STUDY

cross dev-app: run on multiple dev in parallel

- Eyes-free touch UI design



- Standard UI classic

(swipe direction instead of button)

- popup on whiteboard

→ compare 3 designs
- best / efficient / less errors
- popular / low effort / ...

design > implement > pilot > recruit > run > report

design	implement	pilot	recruit	run	report
conditions tasks measure	setup logging location	1/2 (devs) → improve design/impl	- appointm. - rewards	execute collect data	statistical analysis

bias in group? sample?

record (log) all actions + questionnaire

Analysis

- completion times

tasks: switch color / thickness

preprocess > overview > stat > charts

#extra actions = #performed - #necessary

eyes free ↔ classical (also eyes free) ← unexpected! eyes tracking?

perceived efficiency / rating

→ by a bit/smart

carry over effects
unexpected happens - be ready
often participants a lot of variation

challenges: distributed system - many configurations

XDTools (enable devices) configurations ... record/replay

Eval: which features?

△ time constraints → do lab exp. es 2h controlled

M b. DIGITAL PEN & PAPER

(revisiting ed fest)

~~Paperless office~~ paper & electronic devices work together

Paper - Digital divide (techn + sw)

Digital pen:

bluetooth
camera
memory (store data)
coordinates (Anoto pattern)

Automated form processing → gidgets: pieces of pattern pasted on page, interpreted commands

Interactive paper
1. define area
2. link to digital media

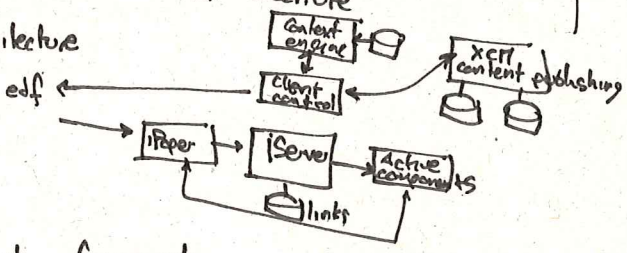
→ multimedia recording (audio)

Paperpoint: control ppt from printed handout
↳ annotations / sketching

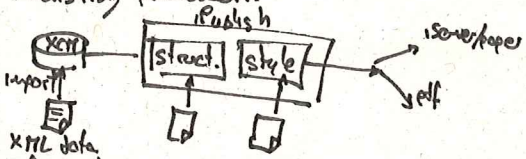
iPaper framework

Edfest: tourist guide with pen (input/audio output) | interactive event brochure
↳ extra realtime data
interactive event brochure

Architecture



Publishing framework



Print-n-link (audio link of publications) [E]

Paperproof: paper & digital editing in parallel (maintain mapping P ↔ D)

iGesture / iTable (pen-based interactive surfaces)

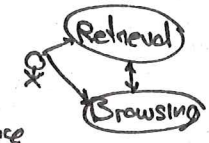
user studies
don't let techn & mmg drive app development - user studies! (they will find it too complex otherwise)

ahead of time → need technology support

set clear goals
keep developing team together (artists / programmers / designers / UI / UI experts ...)
use good framework

12. LIGHTROOM CASE STUDY (design process & user survey)

Task analysis
- what / how / knowledge



Uses:
requirements / design / impl / doc / performance
→ task-focused (function)

Task taxonomy (identify): card sorting
- discard
- create
- group
→ find essential

Lightroom: photography workflow
↳ modular / task based environment

Adobe

Shadowland (lead, UI des, UI researcher)
↳ systematic research

users: site visit / phone interview
- discuss workflow (manage / store / search / publish)

- wedding (slideshow)
- landscape (tiles)
- studio (post proc)
- wildlife (moment) / sports

⇒ multiple used apps → slowdown
tight PS integration

Shadowland
- organize img (smart collection)
- select / rate / flag / keyword
- compare (post-process) → basic features included
- slideshow / print / web

library > develop > slideshow > print > web

workflow (custom) — tool freedom (steps)

PIM: personal info management — workflow

PUBLIGHT

Lightroom online questionnaire (vs tutorials / books / ...)
- bg questions (age / gender / ..)
- scales (agree / disagree) with statement (Likert item) — scale (% of responses)
- multiple choice
- open questions

→ only ask what's relevant (otherwise turn off)
ranges better than values (more anonymous) / optional
put @ end

recruit → find target audience
→ emails / forums / social media ⚠ sample good?

Reward / prize ⚠ drawbacks (motivation, ...)

no long questions → lose participants, simple language
open questions → effort

issues
- adding / correcting questions
- do I submit
- ...

⇒ key findings
reluctant to spend time on organize for future speedup
capture time is very relevant

---

survey exercise email
ZV V/SBS interface issues

13. COMMONIC & COLLABOR. (working & living together)

COMM: goal of many apps (direct / media share / social netw / team)

HCI: (H) ↔ (C) & ↔ (H)

everything is communication | content | relationship (meta comm)
content: words | extra info | classifies

Rules of comm
speaker decides → next (person)
next person starts
speaker continues

speaker → receiver | how they see & perceive

else: interrupt

how long to 1 talk: verbal & physical comm: - body rocking / gesh - glance

adjacency pair: alternation A → B (coordination / coherence)
(pairs of utterances)

e-mail: turn-taking (1:1, 1:N) → emotion to add interpretation
signal

social media: relationships: • new • old-continue (lightweight)

Analysis/eval
- understand online community

rich media
- video, ... (aspire face2face)

lean media
- text only

collaboration
- goal oriented
- partnership

collaboratory
- organisational forms to support collab (between scientists)

crowdsourcing
- unknown participants → motivation? (KS)
- quality assurance?

-ethical / social / economical implication

best mean for comm? email

Automattic → work from home (get together 1/year)

Doodle

Collab	Crossover	Social Media
email / phone / audio video conf	wiki / blogs / chats	chat / tagging
Skype, google docs..	wikip / twitter / linkedin	YT, Fb, ...
2-2000		20-2001

	same time synch	≠ time asynch
same place doc	face2face	continuous task proj. management
≠ pl remote	remote interaction (conf)	comm / collab / coord email / forum shared repositories...

- video conferencing (DVE immersion room)
- collaborative editing (alg to allow parallel work) undo / redo / privacy + awareness
no conflict between users

Hierarchical doc (D-P-S-W-C)

D — history → keep history of operations
...

Awareness mechanism-architecture

aw. visualization
aw. computation
consist. alg — collaborative editor
structured doc — ops

aw. mechanism
- data model
- edit profile

text editor U study

shadow doc sets
- since last login
- current uncommitted
- — committed

awareness info
- profile

CS: BeAware

op → ghost op generator (remote U) → gop → Netw → gop → current comp (local U) → op Val

mask — remote — privacy sensitive env

loc copy (user's view)
- support collab & avoid conflict
- ⇒ awareness !!
- balance of info & privacy

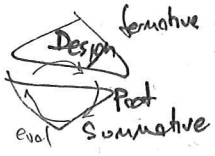
HCI

r_0 r_1 r_2 r_3 $\in P_3$

HCI → discipline design/eval/impl

Formative ↔ build ↔ evaluative

understand prob/user eval our design



1-3 Human capabilities
perception
HHP

4-5 quantitative methods

6-7 Design cycle / int style

8-9 Qualitative methods

10-14 UX design case studies

failing to prepare = preparing to fail

HCI RECAP

MHP measure/predict - exec time/error rate - training effect

$T_p = 100_{ms}$ perceptual — perceive

$T_c = 70_{ms}$ cognitive

$T_M = 70_{ms}$ motor

Block's law

$R = It$ (intensity, exposure time)

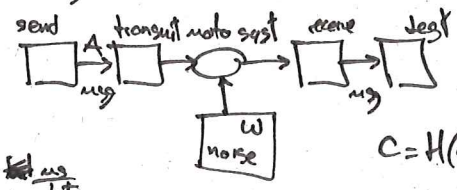
operate on unit
chunking 7±2

saccade 30ms ≤600°/s
Fixation 90% 300ms

Fitt's law: used to $MT = I_M \cdot I_D$ $\frac{ms}{bit} \cdot bit$ $IP = I_M^{-1}$ $\frac{bit}{ms}$

I_D: # bits used to describe movement $I_D = \log_2\left(\frac{2D}{\omega}\right)$

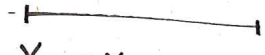
→ use to optimize GUI
measure throughput in aimed movt / ~~exact~~ mov time perform



$I_M = 100$ ~~bit~~ $\frac{ms}{bit}$

$C = H(sig) - H(noise)$
$= a + b\log_2\left(\frac{A}{\omega} + 1\right)$

$n(T + \tau + C) = MT = I_M I_D$



$X_1 = \varepsilon X_0$
$X_n = \varepsilon^n D$
stop when $\varepsilon^n D \leq \frac{\omega}{2}$ ✓

$I_M = \frac{n(T+\tau+T)}{I_D}$

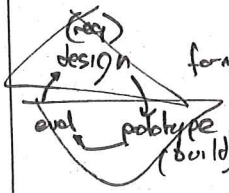
$= \frac{-\log\frac{2D}{\omega}(T+\tau+T)}{\log\varepsilon \quad \log\frac{2D}{\omega}} = -(T+\tau+T)/\log\varepsilon$

$\varepsilon^n \leq \frac{\omega}{2D}$

$n \leq \log_\varepsilon \frac{\omega}{2D}$

$n \geq -\log\frac{2D}{\omega} / \log\varepsilon$

2D motion $\frac{A}{\omega}$ ω' $\min(\omega, H)$ or $\log_2\left(\sqrt{\left(\frac{A}{\omega}\right)^2 + \omega\left(\frac{A}{H}\right)^2} + 1\right)$



analytical
empirical

QEM (quantitative) • effectiveness
• efficiency
• satisfaction

Design empirical study
1) what is being compared? indep
2) _____ in? dep
3) ~~distractor factors~~ what alt-vares? ext fact

categorical cat
ordinal #
ordinal ⌴

within subj everything does everything

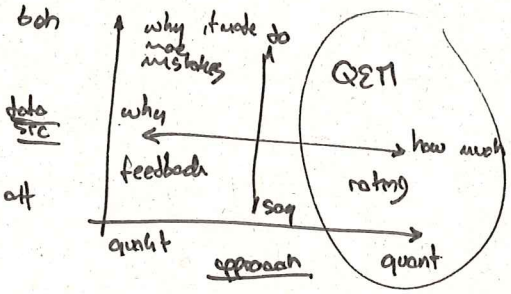
⊕ require less subj
no bias of group
every data/exact comparison

⊖ biased by order

between subj divide in groups, do only task

⊕ unbiased, only know their condition

⊖ grouping / different conditions



$O_i = M_i + \varepsilon_i$

$b_0 + b_1 X_i$ err mean mode predictor regr/st test

$O = b + \varepsilon$
$O = \rho X + \varepsilon$
$O = (b_0 + b_1 X) + \varepsilon$

tot err $\Sigma(x_i - \bar{x})$

$SS = \Sigma(x_i - x)^2$

$\frac{SS}{N-1} = \sigma^2$ $SD = \sigma = \sqrt{SS/N-1}$

H x effects y
H_0 doesn't

$t = \frac{M_B - M_A}{var_B}$

out p val: how much we believe H_0
$p < 0,05$

CLT

$\sigma_{\bar{x}} = \frac{SD}{\sqrt{N}}$ st. err approx

confidence $\bar{X} - \left(\frac{z - p}{2} \times SE\right)$
+

Type 1: reject true hyp
Type 2: keep false

UCD

Interaction styles / paradigms

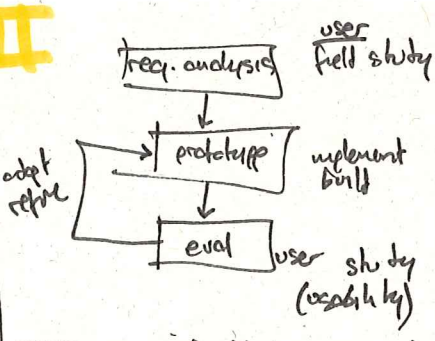
- command (line)
- dialogue-based
- browse/search
- direct manip — visible
  — small incr steps/undo / rapid
  no complex syntax

- context sensitive UI
- natural interfaces (long)
- AR/VR

sensor techn/placement } interaction tasks | input recogn syst output

usability goals: effective, efficient, consistent, satisfaction, safe, useful, easy learn/remember

II



paper
- facilitator (guides)
- computer
- observer
- helper user (provide info)

design principles
- visibility
- feedback
- consistency
- constraint
- mapping
- affordances

shades of blue colour blindness

spaces/structure input forms

Gestalt

multistability
emergence
continuity
closure
invariance
similarity
proximity

reification
continuity

HCI: STROKES & GESTURE

gesture-based interaction (issues + challenges), 2D/3D recognition

brain areas (hand & speech) co-developed

Functions

sensory ← tactile sensing | haptic sens | tool manip | abstract skilled manip → motor

Prehensile: (holding/manip/transport) apply force with hand to obj to task

non-preh (gesture) (point/aim/tag/type/play instrument)

↳ co-verbal or speech substitute (comm)

↳ motion that conveys info

Kinect ★Videoplace

pose estimation pipeline

capture depth/ remove bg → infer body parts/px → cluster px, hypothesize body joint pos → fit model track skeleton

sign processes & meaningful comm.

Semiotic gesture

- symbolic (meaning in culture)
- pantomimic (use invisible obj)
- iconic (info size/shape)
- deictic (referential spatial, direct attention)

formal gestures (eg. traffic)

Shape/(pose)
static config body, hand

Gesture
involve movement body, hand, tool, pen..

Issues in gesture based UI

① what is good gesture?
- apply multitouch set
- surface gesture

- design
- consistency
- memorability
- customize
- segment
- registration
- recogn
- completeness

user-defined are better

② segmentation prob
- detect beginning & end

gloves (eg charade)
↳ outside active zone = ignore

③ not self-revealing
- ??

④ how to undo